Memoranda of the Field Experiments at Rothamsted, May 1873

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Rothamsted Research

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MEMORANDA

OF THE

PLAN AND RESULTS

OF THE

FIELD EXPERIMENTS

CONDUCTED ON THE

FARM OF JOHN BENNET LAWES, Esq.,

AT

ROTHAMSTED, HERTS.

MAY, 1873.

https://doi.org/10.23637/ERADOC-1-237

THE PARK.

Experiments with different Manures on PERMANENT MEADOW LAND.

The Land has probably been laid down with Grass for some centuries. No fresh seed has been artificially sown within the last 40 years certainly; nor is there record of any having been sown since the Grass was first laid down. The experiments commenced in 1856, at which time the character of the herbage appeared uniform over all the Plots. Excepting as explained in the Table, and in the foot-notes, the same description of Manure has been applied year after year to the same Plot.

(Area under experiment, about 7 acres.)

		Produce per Acre, weighed as Hay.					
Plots.	Manures, per acre, per Annum.	14th Season; 1869.	15th Season; 1870.	16th Season; 1871.	17th Season; 1872.	Average per Annum; 16 Years 1856-1871.	Plots.
		Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	
1	1856–63, 8 years, 14 tons Farmyard Manure, and 200 lbs. Ammonia-salts [1]; average produce 49½ cwts. 1864 and since, 200 lbs. Ammonia-salts alone; average produce (8 years, 1864–71) 43½ cwts.	61	16¼	43¾	31½	46½	1
2	1856–63, 8 years, 14 tons Farmyard Manure; average produce 42⅞ cwts. 1864 and since, unmanured; average produce (8 years, 1864–71) 38½ cwts.	55¼	13⅞	33⅞	25¼	40⅝	2
3	Unmanured, continuously	38	5⅜	25⅜	14⅝	22⅞	3
4 (1)	3½ cwts. Superphosphate of Lime [2]	40¼	7¼	24⅝	15¾	24⅝ [9]	1
4 (2)	3½ cwts. Superphosphate of Lime, and 400 lbs. Ammonia-salts	45½	8¼	38¼	28½	36¼ [9]	2 4
5	400 lbs. Ammonia-salts	35⅝	5½	29⅝	22½	28½	5
[3] 6	1856–68, 13 years, 400 lbs. Ammonia-salts; average produce 30½ cwts. 1869 and since, 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos.; av. prod. (3 yrs., 1869–71) 36¾ cwts.	56½	16¼	37½	25¼	31¾	6
7	300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	54⅝	17½	39⅜	37¾	35⅜	7
[3] 8	1856–61, 6 years, 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwts. Superphosphate; average produce 36 cwts. 1862 and since, 250 lbs. [5] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate; average produce (10 years, 1862–71) 30 cwts.	46⅜	12¾	30	22⅞	32¼	8
9	300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate, and 400 lbs. Ammonia-salts	68¾	29½	58¾	50½	52¾	9
[3] 10	1856–61, 6 yrs, 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. 55½ cwts. 1862 and since, 250 lbs. [5] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. (10 yrs., 1862–71) 45¼ cwts.	57¼	21¼	46½	38⅝	49⅛	10
11 (1)	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 800 lbs. [6] Ammonia-salts	75¼	42⅜	56⅝	63⅜	60¾	1
11 (2)	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 800 lbs. [6] Ammonia-salts, and 400 lbs. Silicate Soda [7]	78½	49½	65¾	63⅞	64¼	2 11
12	Unmanured continuously	38¾	11¼	26⅜	20⅛	25¼	12
13	300 lbs. Sulph. Potass, 100 lbs. [4] Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosph., 400 lbs. Ammonia-salts, 2000 lbs. Cut Wheat-straw	77⅝	48	63	62⅝	56¾	13
14	550 lbs. Nitrate of Soda [8], 300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	76⅛	56¼	61⅞	55½	57⅞	14
15	550 lbs. Nitrate of Soda	53¼	15½	38⅝	32⅝	36⅞ [10]	15
16	275 lbs. Nitrate of Soda, 300 lbs. Sulphate Potass, 100 lbs. [4] Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts, Superphosphate	74¼	33⅛	57	40	48⅝ [10]	16
17	275 lbs. Nitrate of Soda	54⅜	19¼	38½	29⅝	35⅜ [10]	17
18	Mixture supplying the quantity of Potass, Soda, Lime, Magnesia, Phosphoric acid, Silica, and Nitrogen, contained in 1 ton of Hay (commencing 1865)	55⅜	14⅝	37⅞	33⅜	37⅞ [11]	18
19	275 lbs. Nitrate of Soda, 290 lbs. Sulphate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	..	40	..	19
20	327 lbs. Nitrate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	..	38½	..	20

1 acre .. .. = (about)	0·40 Hectare .. .. .. or 1·59 Prussian Morgen.
1 lb. (pound avoir.) .. = (about)	0·45 Kilogramme .. .. .. or 0·91 Zollverein Pfund.
1 cwt. (hundredweight) = (about)	51·0 Kilogrammes .. .. .. or 1·02 Centner.
1 ton .. .. = (about)	1016·0 Kilogrammes .. .. or 20·33 Centner.
1 lb. per acre .. .. = (about)	1·12 Kilogramme per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre .. .. = (about)	125·5 Kilogrammes per Hectare or 0·64 Centner per Pr. Morgen.

(1) "Ammonia-salts"—in all cases equal parts Sulphate and Muriate of Ammonia of Commerce.
(2) The "Superphosphate of Lime," is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid Sp. gr. 1·7 (and water).
(3) Plots 6, 8, and 10, had, besides the Manures specified, 2000 lbs. Sawdust per acre per annum for the first 7 years, 1856–1862, but without effect.
(4) 200 lbs. 1856–63 inclusive.
(5) 500 lbs. in 1862 and 1863.
(6) Only 400 lbs. in 1859–60–61.
(7) The application of Silicates did not commence until 1862.
(8) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. of "Ammonia-salts."
(9) Average of 13 years only, as the manures specified were first applied in 1859 (previously, 1856–7 and 8, Sawdust only).
(10) Average of 14 years only, as these experiments did not commence until 1858.
(11) Average of 7 years only, as the experiment only commmenced in 1865.

HOOS FIELD.

Experiments on the Growth of BARLEY year after year on the same Land, without Manure, and with different kinds of Manure.

Previous Cropping—1847, Swedish Turnips, with Dung and Superphosphate of Lime, the Roots carted off; 1848, Barley; 1849, Clover; 1850, Wheat; 1851, Barley manured with Ammonia-salts.

First Experimental Barley Crop in 1852. Barley every year since; and, unless stated to the contrary in the foot-notes, the same Manure has been applied year after year to the same Plot.

(Area under experiment, about 4¼ acres.

1 acre	= (about)	0·40	Hectare	or 1·59	Prussian Morgen.
1 bushel	= (about)	0·36	Hectolitre	or 0·66	Prussian Scheffel.
1 lb. (pound avoir.)	= (about)	0·45	Kilogramme	or 0·91	Zollverein Pfund.
1 cwt. (hundredweight)	= (about)	51·0	Kilogrammes	or 1·02	Centner.
1 bushel per acre	= (about)	0·9	Hectolitre per Hectare	or 0·42	Pr. Scheffel per Pr. Morgen.
1 lb. per acre	= (about)	1·12	Kilogramme per Hectare	or 0·57	Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre	= (about)	125·5	Kilogrammes per Hectare	or 0·64	Centner per Pr. Morgen.

Plots.	Manures, per acre, per annum.	Produce per Acre. Average per Annum, over 20 Years, 1852–1871. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	Twenty-first Season, 1872. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	Plots.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	
1 O.	Unmanured continuously	20	52⅜	11⅜.	10¼	53¼	6	1 O.
2 O.	3½ cwts. Superphosphate of Lime (1)	25½	53¾	13⅜	15⅝	54¼	6⅞	2 O.
3 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	22½	53	12¼	10½	53½	6½	3 O.
4 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	27½	53⅜	14⅜	14¼	53⅜	7⅝	4 O.
1 A.	200 lbs. Ammonia-salts (4)	32½	52½	18½	26¼	52½	15¼	1 A.
2 A.	200 lbs. Ammonia-salts, and 3½ cwts. Superphosphate	47	53½	27⅝	39⅜	53½	22⅞	2 A.
3 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	35	52¾	20¼	30⅜	53½	17⅜	3 A.
4 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	46¼	54	28½	36⅞	54¼	24¼	4 A.
(5) 1 AA.	275 lbs. Nitrate Soda	37	52	22⅛	26¾	52⅜	16⅞	1 AA.
(5) 2 AA.	275 lbs. Nitrate Soda, and 3½ cwts. Superphosphate	49¼	53⅜	30½	38⅝	53½	23¾	2 AA.
(5) 3 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	37¾	52¼	24⅜	29½	54½	19¾	3 AA.
(5) 4 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	49¾	53⅜	32⅜	32	53½	22	4 AA.
(5) 1 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6)	37	54½	21⅞	33	53⅛	20½	1 AAS.
(5) 2 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, and 3½ cwts Superphosphate (1)	47¼	55¾	29	38½	53¼	25⅜	2 AAS.
(5) 3 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, and 100 lbs. Sulph. Magnesia	43⅜	55	25⅞	35⅞	54⅜	22⅜	3 AAS.
(5) 4 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwts. Superphosphate	50	55⅞	31½	36⅞	52¼	27⅝	4 AAS.
(7) 1 C.	1000 lbs. Rape-cake	45¼	53⅜	26⅞	30⅛	52½	17⅛	1 C.
(7) 2 C.	1000 lbs. Rape-cake, and 3½ cwts. Superphosphate	46⅜	53⅞	28⅜	33¼	52⅞	19⅞	2 C.
(7) 3 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	43⅜	53¾	27⅛	27⅜	53	17	3 C.
(7) 4 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphosphate	47⅜	53⅜	29½	33⅛	53⅜	20½	4 C.
(8) 1 N.	275 lbs. Nitrate of Soda	37⅜ (11)	52⅝ (11)	22⅞ (11)	33 5/8	52	22⅛	1 N.
(8) 2 N.	275 lbs. (9) Nitrate of Soda	41½ (11)	52⅝ (11)	26⅛ (11)	31⅞	53⅛	20⅛	2 N.
5 O.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate (10)	22¾ (11)	53½ (11)	12⅜ (11)	11	53⅞	6	5 O.
5 A.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate, and 200 lbs. Ammonia-salts	44½ (11)	53½ (11)	28 (11)	30⅞	53¼	20¼	5 A.
M.	100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, and 3½ cwts. Superphosphate	21½ (12)	53¼ (12)	12⅜ (12)	9	53¼	6⅞	M.
6 1	Unmanured continuously	22	52½	12⅜	11	53¼	7	1
6 2	Ashes (burnt soil and turf)	22	52⅜	12⅛	12¾	54¼	6⅜	2 6
7 1	Farmyard Manure 14 tons, 20 years, 1852–1871; unmanured since	48¼	54⅜	28¼	38⅜	53⅝	23⅜	7
7 2	Farmyard Manure 14 tons, every year				38⅞	53	26	

(1) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).

(2) 300 lbs. per annum for the first six years, 1852–7.

(3) 200 lbs. per annum for the first six years, 1852–7.

(4) The "Ammonia-salts"—in all cases equal parts Sulphate and Muriate of Ammonia of Commerce.

(5) First 6 years, 1852–7, instead of Nitrate of Soda, 400 lbs. Ammonia-salts per annum; next 10 years, 1858–67, 200 lbs. Ammonia-salts per annum; 1868, and since, 275 lbs. Nitrate of Soda per annum. 275 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 200 lbs. "Ammonia-salts."

(6) The application of Silicates did not commence until 1864; in 1864-5-6 and 7, 200 lbs. Silicate of Soda and 200 lbs. Silicate of Lime were applied per acre, but in 1868, and since, 400 lbs. Silicate of Soda, and no Silicate of Lime. These plots ("AAS") comprise, respectively, one half of the original "AA" plots, and, excepting the addition of the Silicates, have been, and are, in other respects, manured in the same way as the "AA" plots; and, for the sake of comparison with the latter, the *average produce* is given for the whole period of 20 years, 1852–1871.

(7) 2000 lbs. Rape-cake per annum for the first six years, and 1000 lbs. only, each year since.

(8) 300 lbs. Sulphate of Potass, and 3½ cwts. Superphosphate of Lime, without Nitrate of Soda, the first year (1852); Nitrate alone each year since.

(9) 550 lbs. Nitrate of Soda for 1853-4-5-6, and 7; and 275 lbs. only, each year since.

(10) Ammonia-salts also the first year, but not since.

(11) Average of 19 years only.

(12) Average of 14 years only.

BROADBALK FIELD.

EXPERIMENTS ON THE GROWTH OF **WHEAT** YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1839, Turnips, with Farmyard Manure; 1840, Barley; 1841, Peas; 1842, Wheat; 1843, Oats; the last four Crops Unmanured.

First Experimental Wheat Crop in 1844. Wheat every year since; and, with some exceptions, nearly the same description of Manure on the same Plots each year—especially during the last 21 years. Unless otherwise stated, the Manures are sown in the Autumn before the seed.

(Area under experiment, about 13 acres.)

1 acre	= (about)	0·40 Hectare	or 1·59 Prussian Morgen.
1 bushel	= (about)	0·36 Hectolitre	or 0·66 Prussian Scheffel.
1 lb. (pound avoir.)	= (about)	0·45 Kilogramme	or 0·91 Zollverein Pfund.
1 cwt. (hundredweight)	= (about)	51·0 Kilogrammes	or 1·02 Centner.
1 bushel per acre ..	= (about)	0·9 Hectolitre per Hectare ..	or 0·42 Pr. Scheffel per Pr. Morgen.
1 lb. per acre ..	= (about)	1·12 Kilogramme per Hectare	or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre ..	= (about)	125·5 Kilogrammes per Hectare	or 0·64 Centner per Pr. Morgen.

PLOTS.	Manures, per acre, per annum.	PRODUCE PER ACRE. Average per Annum, 20 Years, 1852–1871. Dressed Corn. Quantity.	Dressed Corn. Weight per Bushel.	Total Straw.	Twenty-ninth Season, 1872. Dressed Corn. Quantity.	Dressed Corn. Weight per Bushel.	Total Straw.	PLOTS.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	
0	Superphosphate of Lime (three times as much as on No. 5 and succeeding Plots)	17¾	58⅜	15¼	17¼	58¾	16¾	0
1	Sulphates of Potass, Soda, and Magnesia (twice as much as on No 5 and succeeding Plots)	15⅛	58⅛	13⅞	10⅞	57⅞	11⅜	1
2	Farmyard Manure (14 tons every year)	35⅞	60	33⅞	32⅜	60¾	33⅜	2
3	Unmanured continuously	14½	57½	13	10¾	59	10¼	3
4	Unmanured for Crop of 1852, and since; previously Superphosphate (made with Muriatic Acid), and Sulphate Ammonia	15¾	58⅜	13¾	11⅜	57⅝	10⅞	4
5 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate of Lime (3)	17	58⅞	15¼	12⅜	60	11⅞	5 (*a* and *b*)
6 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 200 lbs. Ammonia-salts (4)	26⅜	59⅜	24½	20½	60⅛	22⅞	6 (*a* and *b*)
7 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 400 lbs. Ammonia-salts	35¼	59¼	35⅜	29¾	60¼	34⅛	7 (*a* and *b*)
8 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 600 lbs. Ammonia-salts	38¼	59	41⅜	35⅝	60½	45½	8 (*a* and *b*)
9 (*a*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphos., and 550 lbs. Nitrate Soda (5)	36¾	58⅜	41½	40⅝	60	58¼	9 (*a*)
9 (*b*)	550 lbs. Nitrate of Soda (5). (The Nitrate for both 9*a* and 9*b* always sown in the Spring.)	26	56⅜	28¼	23⅜	55½	28⅝	9 (*b*)
10 (*a*)	400 lbs. Ammonia-salts alone, for 1845, and each year since; Mineral Manure in 1844	22½	57⅛	21⅝	18	56¾	21¾	10 (*a*)
10 (*b*)	400 lbs. Ammonia-salts alone, for 1845, and each year since (excepting 1846 and 1850); Mineral Manure in 1844, '48, and '50	25⅞	58	24¾	18¾	55⅞	21¾	10 (*b*)
11 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate	28	57⅜	26⅜	27¼	59⅛	30½	11 (*a* and *b*)
12 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 366½ lbs. (6) Sulphate of Soda	33⅞	59⅛	32⅜	29¼	59¾	32¾	12 (*a* and *b*)
13 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 200 lbs. (6) Sulphate of Potass	33⅞	59⅜	33⅞	29⅞	60½	34¾	13 (*a* and *b*)
14 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 280 lbs. (6) Sulphate of Magnesia	33⅞	59¼	32⅞	30⅜	59⅝	33⅞	14 (*a* and *b*)
15 (*a*)	200 lbs. (1) Sulph. Pot., 100 lbs. (2) Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. (7); 400 lbs. Amm.-salts, sown in Spring (8)	32⅞	59⅝	32½	30½	60½	35⅞	15 (*a*)
15 (*b*)	200 lbs. (1) Sulph. Pot., 100 lbs. (2) Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. (7); 400 lbs. Amm.-salts, sown in Spring (9)	34	59¾	33⅞	32⅜	60¾	36⅞	15 (*b*)
16 (*a* and *b*)	1852–64, 13 years, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos., and 800 lbs. Ammonia-salts; average produce 39⅜ bush. Corn, 46⅜ cwts. Straw .. .. 1865 and since, unmanured; average produce (7 years, 1865–71) 19¼ bushels Corn, 16⅝ cwts. Straw	32⅜	59	36⅛	13⅛	59⅜	13⅞	16 (*a* and *b*)
(10) 17 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	17⅝ (12)	58⅞ (12)	16⅛ (12)	25⅞ (14)	60⅝ (14)	29½ (14)	17 (*a* and *b*)
(10) 18 (*a* and *b*)	400 lbs. Ammonia-salts	31⅝ (13)	59⅛ (13)	31¼ (14)	12⅞ (15)	59⅝ (15)	14⅞ (15)	18 (*a* and *b*)
19	3½ cwts. Superphosphate of Lime (11), 300 lbs. Sulphate of Ammonia, and 500 lbs. Rape-cake	30¾	58⅝	29⅛	27¾	59½	29½	19
20	Unmanured continuously	15½ (16)	58 (16)	14½ (16)	11⅜	57⅛	11⅛	20
21	200 lbs. (1) Sulph. Potass, 100 lbs. (2) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., and 100 lbs. Muriate Ammonia	21⅜	58¾	19½	20⅞	59⅜	19¾	21
22	200 lbs. (1) Sulph. Potass, 100 lbs. (2) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., and 100 lbs. Sulphate Ammonia	21	58⅝	19	20⅛	59⅞	18⅛	22

(1) 300 lbs. per annum for Crop of 1858, and previously.
(2) 200 lbs. per annum for Crop of 1858, and previously.
(3) "Superphosphate of Lime"—in all cases, excepting for Plot 19, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).
(4) The "Ammonia-salts," in all cases, equal parts Sulphate and Muriate of Ammonia of Commerce.
(5) 9*a* 475 lbs. Nitrate Soda in 1852, 275 lbs. in 1853 and 1854, 550 lbs. each year since; 9*b* 475 lbs. in 1852, 550 lbs. each year since; 550 lbs. is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."
(6) For 1858, and previously—1½ time as much.
(7) For 1872 and previously, made with Muriatic instead of Sulphuric Acid.
(8) For 1872 and previously, 400 lbs. Sulphate Ammonia, sown in the Autumn.
(9) For 1872 and previously, 300 lbs. Sulphate Ammonia and 500 lbs. Rape-cake, sown in the Autumn.
(10) The Manures of Plots 17 and 18 are, year by year, transposed.
(11) Made with Muriatic instead of Sulphuric Acid.
(12) Average of 20 years' Mineral Manures, alternated with Ammonia-salts.
(13) Average of 20 years' Ammonia-salts, alternated with Mineral Manures.
(14) Plots 17 had the Ammonia-salts for the Crop of 1872.
(15) Plots 18 had the Mineral Manures for the Crop of 1872.
(16) Average of 19 years only; as in 1868, owing to a mistake in carting, the produce could not be ascertained.

The Plots marked "(*a* and *b*)" are divided into duplicate portions, "*a*" and "*b*," respectively, which are manured alike; excepting that, for the crops of 1864-5-6 and 7, the "*a*" portions of plots 5, 6, 7, 8, 9, 16, and 17 (or 18), received a mixture of soluble Silicates in addition to the other Manures, but, hitherto, without any material effect; and for the crops of 1868, and since, cut straw (that produced in the previous season) has been applied (instead of Silicates) on the "*a*" portions of plots 5, 6, 7, 8, 11, 12, 13, 14, and 17 (or 18).

GEESCROFT FIELD.

EXPERIMENTS ON THE GROWTH OF **OATS** YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1847 and 1848, Clover, Experimental Manures; 1849—1859, Beans, Experimental Manures; 1860, Fallow; 1861 and 1862, Wheat, Unmanured; 1863, Fallow; 1864, Beans, Dunged; 1865, Wheat, Unmanured; 1866, Beans, Unmanured; 1867 and 1868, Wheat, Unmanured.

First Experimental Oat Crop in 1869.

(Area under Experiment, ¾ acre.)

PLOTS.	MANURES, PER ACRE, PER ANNUM.	PRODUCE PER ACRE.											
		1ST SEASON, 1869.			2ND SEASON, 1870.			3RD SEASON, 1871.			4TH SEASON, 1872.		
		Dressed Corn.		Total Straw.	Dressed Corn.		Total Straw.	Dressed Corn.		Total Straw.	Dressed Corn.		Total Straw.
		Quantity.	Weight per Bushel.		Quantity.	Weight per Bushel.		Quantity.	Weight per Bushel.		Quantity.	Weight per Bushel.	
1	Unmanured	Bushels. 36⅝	lbs. 36¾	cwts. 19¼	Bushels. 16⅜	lbs. 35	cwts. 9⅛	Bushels. 20½	lbs. 33½	cwts. 11¼	Bushels. 15	lbs. 36¼	cwts. 7⅛
2	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate of Lime (1)	45	38½	24½	19⅛	35⅛	9⅜	22	35¼	13½	19½	37¾	10⅜
3	400 lbs. Ammonia-salts (2)	56⅛	37½	36⅞	30	34⅞	17¼	57⅛	36⅜	40⅝	55¾	37½	30⅝
4	400 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	75¼	39¼	54	50⅝	36	28⅜	58⅝	35⅜	50	62⅜	39½	45⅛
5	550 lbs. Nitrate of Soda (3)	62¼	38½	42¾	36½	35¼	23	55	36⅝	34¾	42⅛	36⅝	20⅝
6	550 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	69⅜	38½	49⅞	50	35¾	28¾	60¼	33¾	48⅜	44⅝	37¼	24

(1) "Superphosphate of Lime"—in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1·7 (and water).
(2) "Ammonia-salts"—in each case, equal parts Sulphate and Muriate of Ammonia of Commerce.
(3) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."

EXPERIMENTS ON THE GROWTH OF LEGUMINOUS CROPS.

I.—Beans, Peas, and Tares—Geescroft Field.

Experiments on the growth of Leguminous corn-crops (beans, peas, and tares), with different descriptions of manure, were commenced in 1847, about nine acres being devoted to the purpose.

Experiments with Beans were continued for thirteen consecutive seasons, to 1859 inclusive; but, during the later years, the crop fell off very much, and the land became very foul.

In 1860 the land was fallowed.

In 1861 a crop of wheat, without manure, was taken.

In 1862 beans were again sown, but with some variation in the manuring.

In 1863 the land was fallowed.

In 1864, 5, 6, 7, 8, and 9, beans were grown, with much the same manures on the same plots, each year, as in 1862.

In the winter of 1869-70, 5000 lbs. of fresh burnt lime were applied per acre, over all the plots.

In 1870 beans were grown with the same manures on the respective plots as in 1864-69.

In October, 1870, winter beans were sown (without manure), but the plants were to so great an extent destroyed by the severe weather which followed, that, in April 1871, the crop was ploughed up, and the land left fallow.

During the winter and early spring of 1871-2, the land was so wet that it could not be prepared in time for sowing. It was therefore left fallow for 1872, at the end of May subsoiled to a depth of about 12 inches, and re-ploughed in July. The winter and early spring of 1872–3 were also so extremely wet, that it was again impossible to prepare the land in time for sowing; it was, however, ploughed up towards the end of March, and is again left fallow.

The general result of the experiments with Beans has been, that mineral constituents used as manure (more particularly potass), increased the produce very much during the early years; and, to a certain extent, afterwards, whenever the season was favourable for the crop. Ammonia-salts, on the other hand, produced very little effect; notwithstanding that a Leguminous crop contains two, three, or more times as much nitrogen as a Graminaceous one grown under similar conditions as to soil, &c. Nitrate of soda has, however, produced marked effects. But Leguminous crops grown too frequently on the same land seem to be peculiarly subject to disease, which no conditions of manuring that we have hitherto tried seem to obviate.

Experiments with Peas were soon abandoned, owing to the difficulty of keeping the land free from weeds, and an alternation of Beans and Wheat was substituted; the beans being manured much as in the experiments with the same crop grown continuously as above described. But the wetness of the winter of 1871–72 prevented the sowing of the Beans for the season of 1872; and again the wetness of the autumn and winter of 1872-3 prevented the sowing of the wheat until April 4, 1873, when Nursery wheat was put in.

In alternating Wheat with Beans, the remarkable result was obtained, that nearly as much wheat, and nearly as much nitrogen, were yielded in eight crops of wheat in alternation with the highly nitrogenous beans, as in sixteen crops of wheat grown consecutively without manure in another field, and also nearly as much as were obtained in a third field in eight crops alternated with bare fallow.

Experiments with Tares, like those with Peas, were soon abandoned, and for the same reasons. Beans were at first substituted, with some variation in the description of the manures employed; but this experiment has likewise been abandoned for some years.

II.—Red Clover (*Trifolium pratense*)—Hoos Field.

Experiments on the growth of Clover, with many different descriptions of manure, were commenced in 1849, and, with the occasional interposition of a corn-crop, or fallow, have been continued up to the present time.

As with other *Leguminous* crops, the result was, that mineral constituents applied as manure (particularly potass) considerably increased the early crops; whereas ammonia-salts had little or no beneficial effect, and were sometimes injurious. It may be added that, even up to the present time, the beneficial effects of long previous applications of potass are apparent whenever there is any growth at all. To go a little more into detail:—

In the first year, 1849, the crops were throughout very heavy; especially with mineral, and without nitrogenous manure.

In autumn 1849 wheat was sown, and in spring 1850 Red Clover. In 1851 small cuttings were taken; and in 1852, though the crops were not heavy, there was by no means a failure. Since that time, however, all attempts to grow clover year after year on the same land have failed to give anything like a full crop, or a plant which would stand the usual time on the ground. Small cuttings were obtained in the autumns of 1855 and 1859 from seed sown in the spring of those years, and small but rather heavier cuttings in June and August 1865, from seed sown in 1864.

On two occasions (1851 and 1854), heavy dressings of Farmyard dung were applied to some of the plots; and in 1854 some received a dressing of 20 tons of dung, and 5000 lbs. of lime, per acre.

On some portions of the land Clover-seed has been sown 10 times during the 23 years, and more frequently alone than with a corn-crop; but in 7 out of the last 8 trials the plant has died off in the winter and spring succeeding the sowing the seed.

In view of these failures in the field, it is a fact of much interest, that in 1854 Red Clover was sown in a garden, only a few hundred yards distant from the experimental field, on soil which has been under ordinary garden cultivation for probably two or three centuries, and it has every year since shown very luxuriant growth; and, after re-sowing 4 times during the period, namely, in 1860, 1865, 1868, and 1871, there is at the present time (spring 1873) a luxuriant plant on the ground.

In reference to the field experiments, it may be added that, in 1864, a portion of the land was trenched 2 feet deep, and one-third of the manure was mixed with the layer from 24 to 16 inches, one-third from 16 to 8 inches, and the remainder from 8 inches upwards. Owing to the characters of the season, the mechanical condition of the land was at first very unfavourable after this treatment; but, although many years have now elapsed, and the excess of constituents supplied was in some cases considerable, the plant has died off as completely on these plots as elsewhere.

Again, in the winter of 1867-8 small portions of the experimental land were dug, some to the depth of 9 inches, some to the depth of 18, some to the depth of 27, and some to the depth of 36 inches, and sown to the respective depths with different mixtures; supplying in some cases very large amounts of potass, soda, lime, magnesia, phosphoric acid, sulphuric acid, nitrate of soda, &c. From other similar sized plots, the soil was removed to the depths of 9, 18, and 27 inches respectively, and replaced by soil taken at the same depths from the garden border, on a portion of which clover had been grown successfully since 1854, as above referred to. In April 1868 clover was sown over the whole of these small plots, and on some other portions of the land not so treated; but the plant for the most part died off during the following winter.

In April 1869 the same portions were re-sown, small quan-

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tities of clover were cut in September of that year, but the plant again died off in the winter.

In April 1870 Clover was sown over the whole of the experimental land, this time in conjunction with Barley; but on those portions which had also been sown in 1868 and 1869 the plant again died off during the winter and early spring; whilst from those which had not been sown in 1868 and 1869 two small cuttings were taken in 1871. In the spring of 1872, the plant being then almost entirely gone, the land was ploughed up. It was again ploughed in July 1872, and in March 1873; the intention being to sow some other leguminous crop; but owing to the wetness and lateness of the season this has not been done, and the land again lays fallow.

In the spring of 1871 the *small* plots in the field were again re-sown, and those of the garden-soil were entirely enclosed, both around and above, by galvanised wire netting. Small cuttings were taken from these small beds in July 1872; and at this time (May 1873) there is a fair plant on most of them, but less on those with garden soil than on several of the others from which less was taken last year.

The general result of the experiments in the field is—that neither organic matter rich in carbon as well as other constituents, nor ammonia-salts, nor nitrate of soda, nor mineral constituents, nor a complex mixture, supplied as manure, whether at the surface or at a considerable depth, has hitherto availed to restore the clover-yielding capabilities of the land.

On the other hand, it is clear that the garden-soil has supplied the conditions under which clover can be grown year after year on the same land for many years in succession.

The results obtained on the garden-soil seem to show that what is called "clover-sickness," cannot be due to the injurious influence of excreted matters upon the immediately succeeding crop.

That Clover frequently fails coincidently with injury from parasitic plants, or insects, cannot be disputed; but it may be doubted whether such injury should be reckoned as the cause, or merely the concomitant and an aggravation, of the failing condition.

The results of the experiments seem, therefore, to exclude the supposition that the primary cause of failure is either destruction by parasitic plants or insects, injury from excreted matters, or the shade of a corn-crop, and to indicate that it must be looked for in exhaustion of the soil. Still there remain several open questions. Is it exhaustion of certain organic matters rich in carbon, of nitrogenous food, or of mineral constituents? Again: is there an absolute deficiency in the soil of some of the substances in question, or only an unfavourable condition of combination, or, so to speak, of *soil-digestion* of them, for the requirements of Leguminous plants? Or is there only an unfavourable distribution of them within the soil, considered in relation to the extent and character of the root-range of the crop?

These various suggestions cannot be further considered within the limits of this brief notice, which may be concluded by the following quotation from Rothamsted papers on the subject ('Journal Royal Agricultural Society of England,' vol. xxi. Part I. p. 178; and 'Journal Royal Horticultural Society of London, vol. iii. p. 86, 1872).

"When land is not what is called 'clover-sick,' the crop of clover may frequently be increased by top-dressings of manure containing potass and superphosphate of lime; but the high price of salts of potass, and the uncertainty of the action of manures upon the crop, render the application of artificial manures for clover a practice of doubtful economy.

"When the land is what is called 'clover-sick,' none of the ordinary manures, whether 'artificial' or natural, can be relied upon to secure a crop.

"So far as our present knowledge goes, the only means of insuring a good crop of Red Clover is to allow some years to elapse before repeating the crop upon the same land."

BARN FIELD.

EXPERIMENTS ON THE GROWTH OF ROOT-CROPS.

Experiments with Turnips were commenced in 1843. Eight acres, divided into numerous plots, were set apart for the purpose; and the crop was grown for ten consecutive years on the same land ("Norfolk Whites" 1843-1848, and "Swedes" 1849-1852); on some plots without manure, and on others with different descriptions of manure. Barley was then grown for three consecutive seasons (1853-1855) without manure, in order to test the comparative corn-growing condition of the different plots, and also to equalize their condition, as far as possible, by the exhaustion of some of the most active and immediately available constituents supplied by the previous manuring. A new series of experiments with Swedes was then arranged, having regard to the character of the manures previously applied on the different plots, and to the results previously obtained. This second series was commenced in 1856, and continued for 15 years—namely, to 1870 inclusive.

It is impossible adequately to state the bearing of the results in a few words, but the following are some of the most characteristic indications:—

1. Without manure of any kind, the produce of roots was reduced in a few years to a few cwts. per acre; but the diminutive plants (both root and leaf) contained a very unusually high percentage of nitrogen.

2. Of "mineral" constituents, phosphoric acid (in the form of superphosphate of lime) was by far the most effective manure; but, when this manure is used alone, the immediately available nitrogen of the soil is rapidly exhausted.

3. Really large crops of turnips can only be obtained when the soil supplies a liberal amount of both carbonaceous and nitrogenous matter (as well as mineral constituents); and when they are already available within the soil, or are supplied in the form of farmyard manure, rape-cake, Peruvian guano, ammonia-salts, &c., the rapidity of growth and the amount of the crop are greatly increased by the use of superphosphate of lime applied near to the seed.

The land is now devoted to experiments with sugar-beet; for particulars of which see next page.

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BARN FIELD.

Experiments on SUGAR BEET,

To be grown year after year on the same Land, without Manure, and with different descriptions of Manure, commencing 1871.

Previous Cropping:—1843–'48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure.
1849–'52 (4 Seasons), experiments on Swede Turnips, with different descriptions of Manure.
1853–'55 (3 Seasons), Barley without Manure (with a view as far as possible to equalise the condition of the Plots).
1856–'70 (15 Seasons), experiments on Swede Turnips, with different descriptions of Manure, in which the arrangement of the Plots was the same, and that of the Manures very similar—in fact, exactly the same during the last 10 years as in the first year of Sugar Beet, excepting that, during those 10 years, the Alkalies were omitted for the Swedes. For the second and subsequent years of Sugar Beet slight alterations in the Manures were made, as will be seen below.

Area under experiment about 8 acres. The experiments are arranged as under, in 5 Series, each of which comprises 8 Plots.

Plots.	Manures, per Acre, per Annum.				
	1 acre .. .. .. = (about) 0·40 Hectare .. .. or 1·59 Prussian Morgen. 1 lb. (pound avoir.) .. = (about) 0·45 Kilogramme .. .. .. or 0·91 Zollverein Pfund. 1 cwt. (hundredweight) = (about) 51·0 Kilogrammes .. .. .. or 1·02 Centner. 1 ton .. .. = (about) 1016·0 Kilogrammes .. .. .. or 20·33 Centner. 1 lb. per acre .. .. = (about) 1·12 Kilogrammes per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen. 1 cwt. per acre .. .. = (about) 125·5 Kilogrammes per Hectare or 0·64 Centner per Pr. Morgen. 1 ton per acre .. .. = (about) 2510·0 Kilogrammes per Hectare or 12·82 Centner per Pr. Morgen.	Series 2. Each Plot as Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.	Series 3. Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."	Series 4. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."	Series 5. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake.
	Series 1.				

First Season, 1871.

		Produce per Acre (Roots trimmed as for feeding, not as for Sugar making).									
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure (14 tons)	18 3	3 5	27 13	6 19	22 1	5 6	26 4	6 14	28 18	5 14
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate of Lime (1).	14 13	2 14	25 16	5 15	21 15	4 6	25 2	6 7	25 4	5 5
3	Without Manure (for 30 years)	7 11	2 0	22 3	5 12	15 6	4 16	19 18	7 0	20 16	4 12
4	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 200 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	7 11	1 5	22 15	4 8	17 10	3 5	22 15	6 3	21 7	3 19
5	3½ cwts. Superphosphate	5 12	1 8	20 19	3 14	15 4	3 19	19 18	7 12	18 19	4 5
6	3½ cwts. Superphosphate, and 300 lbs. Sulph. Potass	5 1	1 4	21 5	3 13	17 4	3 4	23 11	6 11	21 0	3 11
7	3½ cwts. Superphosphate, and 300 lbs. Sulph. Potass, and 36½ lbs. Ammonia-salts (2)	5 18	1 5	20 19	3 18	18 8	4 3	21 0	5 0	21 7	3 17
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	7 10	1 14	21 13	3 16	16 2	4 15	17 19	7 11	20 7	4 9

Second Season, 1872.

		Produce per Acre (Roots trimmed as for feeding, not as for Sugar making).									
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure (14 tons)	15 13	4 2	23 9	7 19	22 14	9 0	26 8	9 11	22 5	6 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate of Lime (1)	16 0	3 18	24 6	8 16	22 0	7 16	25 9	9 14	20 15	5 11
3	Without Manure (for 30 years)	7 17	1 13	21 7	6 6	15 3	4 13	20 8	10 1	16 3	3 11
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), and 200 lbs Sulphate Magnesia	6 14	1 10	20 2	5 19	15 10	3 7	23 8	7 13	17 18	3 15
5	3½ cwts. Superphosphate	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4	15 18	3 16
6	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9	15 17	3 14
7	3½ cwts. Superphosphate, and 500 lbs. Sulph. Potass, and 36½ lbs. Ammonia-salts (2)	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10	15 10	3 15
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	5 4	1 5	15 6	5 19	13 10	4 1	19 12	9 17	15 0	4 6

Third Season, 1873; Manures, &c., exactly as for 1872.

(1) "Superphosphate of Lime"—in all cases made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1·7 (and water).
(2) "Ammonia-salts"—in each case equal parts Sulphate and Muriate of Ammonia of Commerce.

AGDELL FIELD.

Experiments on an actual Course of Rotation—Turnips, Barley, Leguminous Crop (or Fallow), and Wheat.

These Experiments were commenced in 1848; so that the present crop (1873) is the 26th experimental one, or the second crop of the Seventh Course
One-third of the land has been continuously unmanured; one-third manured with Superphosphate of Lime alone once every four years, that is for the turnip-crop commencing each course; and one-third manured (also for the turnip-crop only) with a complex manure, as described in the foot-note, No. 2.
In the Second, Third, Fourth, Fifth, and Sixth Courses, instead of clover, half of each plot was sown with beans, and the other half left fallow; for the third crop of the Seventh Course clover is again sown (spring 1873), on half of each plot, the other half being left fallow.
From half of each of the three plots the whole turnip-crop (roots and leaves) was removed; and on the other half the roots were eaten on the land by sheep, and the uneaten leaves spread and ploughed in. In the case of all the other crops, the total produce was removed from the land.
The abstract of results given below relates to the portions of each plot from which the turnip-crops were entirely removed; and on which, in the later courses, beans (not fallow) replaced the clover.

(Area under experiment, about 2½ acres.)

1 lb. (pound avoir.) per acre .. = (about) 1·12 Kilogramme per Hectare, or 0·57 Zollverein Pfund. per Prussian Morgen.
1 cwt. (hundredweight) per acre = (about) 125·5 Kilogrammes per Hectare, or 0·64 Centner per Pr. Morgen.

Years.	Description of Crop.	Produce per Acre. Plot 1. Unmanured continuously. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]	Plot 2. Superphosphate of Lime,[1] alone, for the Turnip Crops only. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]	Plot 3. Complex Manure,[2] for the Turnip Crops only. Corn[3] (or Roots).	Straw (or Leaf).	Total Produce.[4]
1st Course, 1848–51.										
1848	Norfolk White Turnips	65½ cwts.	45⅜ cwts.	111½ cwts.	225⅜ cwts.	106½ cwts.	332 cwts.	218 cwts.	151⅜ cwts.	369⅜ cwts.
1849	Barley	44⅞ bush.	2983 lbs.	5656 lbs.	29⅝ bush.	2111 lbs.	3841 lbs.	28⅝ bush.	2088 lbs.	3794 lbs.
1850	Clover (calc[d]. as hay)	..	..	54 cwts.	..	..	57¾ cwts.	..	..	63 cwts.
1851	Wheat	28½ bush.	3431 lbs.	5389 lbs.	28 bush.	3371 lbs.	5253 lbs.	28⅞ bush.	3552 lbs.	5500 lbs.
2nd Course, 1852–55.										
1852	Swedish Turnips	26 cwts.	4¼ cwts.	30¼ cwts.	223½ cwts.	20½ cwts.	243½ cwts.	396½ cwts.	36½ cwts.	433 cwts.
1853	Barley	34⅜ bush.	2430 lbs.	4465 lbs.	28⅜ bush.	1873 lbs.	3560 lbs.	38½ bush.	2604 lbs.	4873 lbs.
1854	Beans	5½ bush.	1055 lbs.	1445 lbs.	5⅞ bush.	1103 lbs.	1534 lbs.	9⅞ bush.	1355 lbs.	2065 lbs.
1855	Wheat	35½ bush.	3619 lbs.	5859 lbs.	35¾ bush.	3525 lbs.	5789 lbs.	37⅛ bush.	3942 lbs.	6371 lbs.
3rd Course, 1856–59.										
1856	Swedish Turnips	32 cwts.	2¼ cwts.	34¼ cwts.	136 cwts.	7¼ cwts.	143½ cwts.	333¾ cwts.	12½ cwts.	346¼ cwts.
1857	Barley	48½ bush.	2600 lbs.	5337 lbs.	28½ bush.	1475 lbs.	3076 lbs.	48 bush.	2435 lbs.	5168 lbs.
1858	Beans	6½ bush.	1100 lbs.	1515 lbs.	6⅜ bush.	1155 lbs.	1605 lbs.	12⅜ bush.	1520 lbs.	2357 lbs.
1859	Wheat	35½ bush.	4030 lbs.	6262 lbs.	34⅘ bush.	3930 lbs.	6120 lbs.	39¾ bush.	4610 lbs.	7154 lbs.
4th Course, 1860–63.										
1860	Swedish Turnips	1 cwt.	(6½ lbs.)	1 cwt.	29¼ cwts.	1¼ cwt.	30½ cwts.	87¼ cwts.	3¼ cwts.	90¾ cwts.
1861	Barley	38⅝ bush.	2522 lbs.	4718 lbs.	30⅝ bush.	2000 lbs.	3775 lbs.	60⅛ bush.	3940 lbs.	7391 lbs.
1862	Beans	29 bush.	1840 lbs.	3661 lbs.	29⅝ bush.	2150 lbs.	4040 lbs.	43⅜ bush.	3280 lbs.	5990 lbs.
1863	Wheat	44⅞ bush.	3467 lbs.	6350 lbs.	34⅞ bush.	3390 lbs.	5619 lbs.	46⅛ bush.	4697 lbs.	7626 lbs.
5th Course, 1864–67.										
1864	Swedish Turnips	8⅜ cwts.	0⅜ cwt.	9¼ cwts.	68 cwts.	4⅜ cwts.	72⅜ cwts.	176½ cwts.	8⅜ cwts.	185 cwts.
1865	Barley	39 bush.	2154 lbs.	4182 lbs.	33½ bush.	1615 lbs.	3394 lbs.	47⅞ bush.	2595 lbs.	5148 lbs.
1866	Beans	10½ bush.	1013 lbs.	1689 lbs.	7⅜ bush.	978 lbs.	1463 lbs.	20⅛ bush.	1990 lbs.	3343 lbs.
1867	Wheat	21 bush.	2143 lbs.	3473 lbs.	19¼ bush.	1966 lbs.	3222 lbs.	23⅜ bush.	3003 lbs.	4567 lbs.
6th Course, 1868–71.										
1868	Swedish Turnips	Failed, and ploughed up.			Failed, and ploughed up.			Failed, and ploughed up.		
1869	Barley	24⅝ bush.	1948 lbs.	3358 lbs.	28¼ bush.	2025 lbs.	3686 lbs.	42⅞ bush.	3309 lbs.	5800 lbs.
1870	Beans	13⅜ bush.	738 lbs.	1591 lbs.	15⅜ bush.	768 lbs.	1778 lbs.	24⅛ bush.	1056 lbs.	2664 lbs.
1871	Wheat	20⅜ bush.	2799 lbs.	4092 lbs.	23¼ bush.	3048 lbs.	4521 lbs.	23 bush.	3440 lbs.	4883 lbs.
Summary—Average of the 6 Courses, 1848-1871.										
1848, '52, '56, '60, '64	Swedish Turnips	26¾ cwts.	10¼ cwts.	37¼ cwts.	136½ cwts.	28 cwts.	164½ cwts.	242½ cwts.	42½ cwts.	285 cwts.
1849, '53, '57, '61, '65, '69	Barley	38⅜ bush.	2440 lbs.	4619 lbs.	30 bush.	1850 lbs.	3555 lbs.	44⅜ bush.	2829 lbs.	5362 lbs.
1850, '54 '58, '62, '66, '70	Clover, 1850 (calc[d]. as hay) / Beans	.. / 12⅜ bush.	.. / 1149 lbs.	54 cwts. / 1930 lbs.	.. / 13 bush.	.. / 1231 lbs.	57⅜ cwts. / 2084 lbs.	.. / 22½ bush.	.. / 1840 lbs.	63 cwts. / 3284 lbs.
1851, '55, '59, '63, '67, '71	Wheat	30⅜ bush.	3248 lbs.	5238 lbs.	29⅜ bush.	3205 lbs.	5087 lbs.	33½ bush.	3874 lbs.	6017 lbs.

(1) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1·7); Second Course—160 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, and Seventh Courses—200 lbs. Bone-ash, and 150 lbs. Sulphuric Acid, *per acre*.

(2) First Course—100 lbs. Pearl-ash, 100 lbs. Bone-ash, 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 1000 lbs. Rape-Cake; Second Course—300 lbs. Sulphate of Potass, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 160 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, and Seventh Courses—300 lbs. Sulphate of Potass, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, *per acre*.

(3) The quantities given in *Bushels* represent the *Dressed* Corn only.

(4) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, and Total Straw.

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Experiments with Different Descriptions of WHEAT, in 1873; and Summary of Results obtained in previous Years.

Season 1873. Long Hoos Field. 1½ Cwt. Nitrate Soda; after Mangolds with Dung 1872, Sainfoin 1871 and 1870.	Dressed corn per acre. 1868; Sawpit Field; 1 cwt. Guano, 1 cwt. Wheat Manure; after Clover.	1869; Thirty Acres Field; 2 cwts. Guano; after Clover.	1870; Sawyer's Field; 4 cwts. Guano; after Fallow.	1871; Sawpit Field; 3 cwts. Guano; after Mangolds, carted off.	1872; Foster's Field; 2 cwts. Superphosphate, 2 cwts. Nitrate Soda; after Roots, carted off.	Average.	Weight per bushel. 1868; Sawpit Field; 1 cwt. Guano, 1 cwt. Wheat Manure; after Clover.	1869; Thirty Acres Field; 2 cwts. Guano; after Clover.	1870; Sawyer's Field; 4 cwts. Guano; after Fallow.	1871; Sawpit Field; 3 cwts. Guano; after Mangolds, carted off.	1872; Foster's Field; 2 cwts. Superphosphate; 2 cwts. Nitrate Soda, after Roots, carted off.	Average.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1. White-chaff (Red)	.. ..	.. ..	.. ..	.. ..	.. ..	..	.. ..	.. ..	.. ..	.. ..	.. ..	..
2. Rivetts (Red)	.. ..	.. ..	.. ..	.. ..	.. ..	..	.. ..	.. ..	.. ..	.. ..	.. ..	..
3. Chubb Wheat (Red)	.. ..	.. ..	.. ..	28⅜	40	34¼	.. ..	.. ..	.. ..	60¼	61⅞	61⅛
4. Red-chaff (White)	.. ..	.. ..	.. ..	32¾	37	34⅞	.. ..	.. ..	.. ..	61⅝	62¼	62
5. Browick (Red)	.. ..	.. ..	50¼	35¼	40½	42	.. ..	.. ..	64⅛	60	61⅜	61⅞
6. Red Wonder	51⅜	54¾	51	31¼	43¾	46⅜	63	60½	64¾	59	60⅞	61⅝
7. Burwell (Old Red Lammas)	41⅞	48⅛	48⅜	31⅛	41¼	42⅛	64	63	65¾	62	63	63½
8. Bristol Red	.. ..	54¾	50	29⅜	44⅜	44⅝	.. ..	61	65¼	60⅞	61½	62⅛
9. Red Nursery	41⅞	49¼	45	34⅛	45¼	43⅛	66	65	66⅞	63	65	65⅛
10. Red Langham	.. ..	53	49¼	30¾	43¾	44⅛	.. ..	61	65¼	60⅜	61½	62
11. Woolly Ear (White)	44¼	52⅜	47⅝	31¼	42¾	43⅝	64	61½	64⅞	61⅛	62⅛	62¾
12. Hardcastle (White)	.. ..	.. ..	.. ..	.. ..	46½	46½	.. ..	.. ..	.. ..	.. ..	61⅞	61⅞
13. Golden Drop (Red), Hallett's	.. ..	.. ..	.. ..	39½	49¾	44⅝	.. ..	.. ..	.. ..	61⅜	63	62¼
14. Victoria White, Hallett's	.. ..	.. ..	.. ..	33¾	45¼	39½	.. ..	.. ..	.. ..	61	62⅝	61⅞
15. Hunter's White, Hallett's	.. ..	.. ..	.. ..	26⅞	39¾	33⅜	.. ..	.. ..	.. ..	59¼	61¾	60½
16. Original Red, Hallett's	.. ..	.. ..	.. ..	30	35¼	32⅝	.. ..	.. ..	.. ..	58⅝	60	59⅜
17. White Chiddam	49	49⅝	45⅝	26⅞	38¾	42	64½	60½	66⅜	62¼	63	63⅜
18. Red Rostock	46⅝	51¼	.. ..	37	.. ..	45	63½	61¼	.. ..	60⅛	.. ..	61⅝
19. Casey's White	.. ..	.. ..	50½	29⅞	42⅛	40⅞	.. ..	.. ..	64¾	60⅜	61⅛	62¼
20. Golden Rough-chaff (Red)	.. ..	.. ..	.. ..	33	39¼	36⅛	.. ..	.. ..	.. ..	61⅝	62⅛	62⅛
21. Bole's Prolific (Red)	.. ..	.. ..	53¼	33⅝	42¾	43¼	.. ..	.. ..	65⅛	61½	62⅜	63
22. Club Wheat (Red)	.. ..	.. ..	.. ..	36	45¾	40⅞	.. ..	.. ..	.. ..	60⅜	61⅞	61⅛
23. Niagara (Red)	.. ..	43⅛	48⅓	.. ..	.. ..	42¾	.. ..	60½	65	.. ..	.. ..	62¾
24. Clover's Suffolk Red	41¼	.. ..	.. ..	.. ..	.. ..	41¼	64	.. ..	.. ..	.. ..	.. ..	64
25. Golden Drop (Red)	.. ..	50½	50⅓	35¾	.. ..	45⅝	.. ..	62⅓	66	61¼	.. ..	63¼
26. Maynard's (Red)	.. ..	.. ..	.. ..	31⅜	.. ..	31⅜	.. ..	.. ..	.. ..	61⅛	.. ..	61⅛
Mean	45⅕	50⅝	49⅕	32¼	42¼	40⅞	64⅛	61⅝	65⅜	60¾	62⅛	62¼

EXPERIMENTS WITH A VIEW TO ECONOMY IN THE USE OF EXPENSIVE NITROGENOUS MANURES.

It is found that generally less than half the nitrogen supplied in such manures as guano, ammonia-salts, or nitrate of soda, is recovered in the increase of the crop for which they are used; that a considerable quantity may remain in the soil in a comparatively inactive state, yielding increase very slowly; and that a considerable quantity may be carried away by drainage, and lost. It seemed desirable, therefore, to commence a series of experiments to determine whether any saving can be effected by applying comparatively small quantities near to the seed, instead of larger amounts in the usual mode of broadcast sowing and harrowing-in.

It is also intended to make experiments with a view to ascertain the best periods of the year for the application of such manures to different crops.

First Season, 1871.

Experiments upon Wheat. Little Hoos Field. Plots ¼ acre each.

Plot No.	Manures per Acre, &c.	Produce per Acre. Dressed Corn. Quantity.	Dressed Corn. Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.
1	Unmanured. Seed 1 bushel, dibbled 6 inches apart in the rows	23¾	59·3	24½
2	146 lbs. (1) Sulphate Ammonia. Seed 1 bushel; Holes dibbled 6 inches apart in the rows; manure (mixed with Ashes) put in, and seed above	31½	59·1	36¼
3	292 lbs. Sulphate Ammonia. Seed 1 bushel; Manure (mixed with Ashes) sown broadcast, seed dibbled 6 inches apart in the rows	28¾	58·3	35⅝

(1) Containing Nitrogen equal to that in 15 bushels of grain, with its average proportion of Straw.

Experiments upon Barley. Thirty-acres Field. Plots ½ acre each.

Plot. No.	Manures per Acre, &c.	Produce per Acre. Dressed Corn. Quantity.	Dressed Corn. Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.
1	Unmanured. Seed 3 bushels; drilled	40½	53·9	24⅝
2	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and sown broadcast; seed drilled	49⅞	53·3	30½
3	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and drilled; seed drilled above	49½	53·4	28½
4	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; Manures, Ashes, and Seed mixed, and drilled together	51	53·0	30⅜
5	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 1½ bushel; Holes dibbled, 6 inches apart in the rows; Manures (mixed with Ashes) put in, and Seed above	51½	53·3	28¼
6	2 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 3 bushels; Manures mixed with Ashes and sown broadcast; seed drilled	56¼	51·6	32⅞

Second Season, 1872.

Experiments upon Barley. Thirty-acres Field. Plots ½ acre each.

Plot. No.	Manures per Acre, &c.	Produce per Acre. Dressed Corn. Quantity.	Dressed Corn. Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.
1	Unmanured. Seed 2½ bushels, drilled	33⅛	54·4	19½
2	3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2½ bushels; Manures made up to 15 bushels per acre with Ashes, and sown broadcast; seed drilled	46½	54·1	30⅛
3	3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2½ bushels; The Superphosphate mixed with 40 lbs. slaked Lime to neutralize the acid, the Nitrate added, and the whole made up to 15 bushels per acre with Ashes, and sown broadcast; Seed drilled	47⅞	53·6	31⅛
4	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2½ bushels; Manures and Seed made up to 15 bushels per acre with Ashes, and the whole (Manure, Seed, and Ashes) drilled together	42⅜	54·1	26½
5	1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2½ bushels; Manures and Seed made up to 15 bushels per acre with a mixture of half Lime and half Ashes, and the whole (Manure, Seed, Lime, and Ashes) drilled together	43½	53·1	27

Third Season, 1873.

Some experiments are in progress in which a given quantity of Nitrate of Soda (generally at the rate of 1 cwt. per acre) has, by means of plaster of Paris and other substances, been made to adhere to the seed, forming a coating upon it. Experiments in pots, well watered and kept in a greenhouse, showed that barley so coated germinated well, and gave strong and healthy plants; but owing to the wetness of the weather previously, to the consequent lateness of sowing, and to the scarcity of rain since, the coated seeds sown in the field have not come up regularly, and it remains to be seen whether the result will eventually be favourable. Even if it were so, there are practical difficulties in the way of so preparing the seed, which might render the method inapplicable in ordinary practice.

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